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Barnyard Manure

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Conserve — Manure is a valuable by-product of livestock and poultry farming.

Use — Used properly, it increases crop yields, improves crop quality, cuts soil and water loss, builds soil tilth.

UNIVERSITY OF MINNESOTA
Agricultural Extension Service
U. S. DEPARTMENT OF AGRICULTURE

BARNYARD MANURE

A TON OF MANURE applied to your soil is worth $2 to $7 in increased crop yields. Each year, our livestock and poultry produce 40 million tons of manure —enough to grow an additional $700 to $800 worth of crops on every Minnesota farm.

Unfortunately, manure loses its fertilizer value rapidly. So to get full value you have to take care of the manure and apply it properly to your soil.

FERTILIZER VALUE OF MANURE

Manure is a complete fertilizer. It contains nitrogen, phosphate, and potash, as well as other valuable elements. A ton of average manure contains 10 pounds of nitrogen (N), 5 pounds of phosphate (P_2O_5), 10 pounds of potash (K_2O), and 450 pounds of organic matter. However, manure varies considerably in its composition depending upon the farm animal, the kind and quality of feed, and the bedding used.

Manure is not a well-balanced fertilizer for many crops and soils. For best results supplement it with phosphate fertilizer. Apply the phosphate either (1) with a drill or planter at planting time or (2) with the manure. To do this use from 40 to 50 pounds of 20 per cent superphosphate per ton of manure, placing the superphosphate on the load before spreading. The manure increases the effectiveness of the phosphate by preventing it from becoming fixed in the soil.

Poultry manures usually lack potash and should have 25 to 30 pounds of potash fertilizer (0-0-60) added to each ton before application.

Many experiments show that crop increases per pound of nutrients applied in manure are about the same as with chemical fertilizers. However, on soils of poor tilth or on those subject to erosion, the organic matter in manure makes it better than chemical fertilizers.

DON'T LOSE NUTRIENTS FROM MANURE

Careless handling and delayed application result in loss of a large share of manure's value. Poor storage causes big losses through leaching and rotting. Even after the manure is spread on the field, nitrogen in the form of ammonia may escape into the air as a result of drying or freezing. Surface runoff may wash away soluble nutrients, or some of the manure may leach away.

In the Barn—

1. Conserve the liquid manure. Nearly three-fourths of the potash and one-half of the nitrogen are in the urine. Almost all of the phosphate is in the solid excrement but some, like much of the nitrogen and potash in the solid manure, is water soluble and easily leached away.

★ **Make barn floors and gutters tight.**

★ **Use enough bedding to absorb all the liquid.**

Bedding also contributes to the nutrient content of the manure and some types can absorb considerable ammonia nitrogen. The average daily requirement of unchopped straw per head of livestock is 9 pounds for cattle; 10-12 pounds, horses; 1 pound, sheep; and 1½ pounds, hogs. If other types of bedding are used, the amount needed varies considerably.

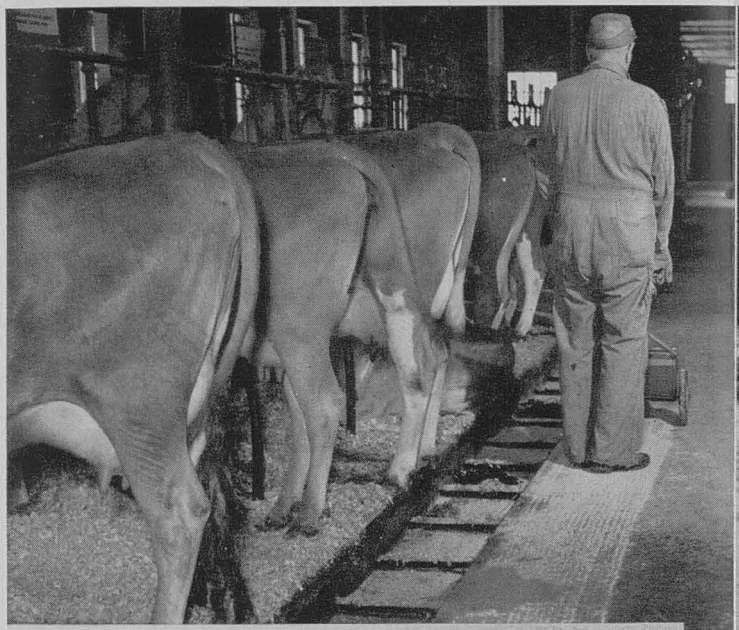
2. Prevent rotting. When manure ferments, nitrogen and organic matter are lost as gases. The strong odor in barns and particularly in chicken houses is due to loss of nitrogen as ammonia from the manure during fermentation (rotting).

To prevent this loss, many farmers spread ground limestone, hydrated lime, gypsum, or superphosphate in the gutters and on the stable floor. All aid the general sanitation of the barn by absorbing some of the liquid and reducing strong odors. However, superphosphate is the most effective in decreasing ammonia losses.

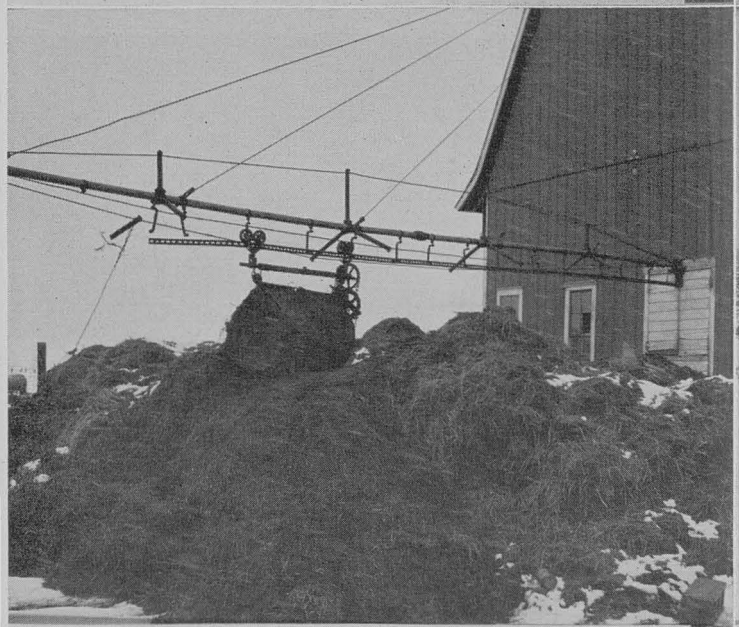
Ground limestone spread on fresh manure neither reduces nor speeds rotting. However, if spread on rotted manure it speeds loss of ammonia.

Hydrated lime, liberally used and brought into close contact with fresh manure, will partially sterilize the manure and temporarily slow ammonia losses. After a short time, however, hydrated lime losses its sterilizing effect by reverting to calcium carbonate, and ammonia losses are encouraged. Using small amounts of hydrated lime on fresh or fermented manure greatly speeds nitrogen losses.

Gypsum (calcium sulfate) has some value as a preservative. When mixed with fresh manure, it changes the ammonia to less active ammonia sulfate. As long as the manure is kept moist, am-



SPREAD SUPERPHOSPHATE (0-20-0) in gutters–This will help to absorb liquid and odors, cut ammonia losses, balance fertilizer nutrients.



BAD PRACTICE–Putting manure in loose, open piles in the barnlot wastes nutrients, hastens losses from leaching and rotting.

SUPERPHOSPHATE AGAIN–Add 40 to 50 pounds of 20 per cent superphosphate per ton of loaded manure to make it a better balanced fertilizer.

GOOD PRACTICE–On fairly level, ice-free fields, spread fresh manure on the snow rather than piling it in the barnlot or field.

monia losses will be cut. If the manure becomes dry, ammonia will again form and be lost.

Superphosphate (0-20-0) contains large amounts of gypsum. It also contains calcium phosphate which prevents the ammonia sulfate (formed by the gypsum) from reverting to ammonia upon drying. At best this treatment saves only a portion of the ammonia in the manure and probably would not be economical for this alone. However, the added superphosphate increases the fertilizer value of the manure. Spread superphosphate in the gutter at from one to two pounds per cow each day.

High-analysis phosphate materials such as treble superphosphate (0-45-0) and calcium metaphosphate (0-63-0) are not good substitutes for ordinary superphosphate because they contain very little if any gypsum.

Use in built-up litters. Superphosphate is particularly effective when used on built-up litter in poultry houses. Gypsum, ground limestone, and hydrated lime are also good in keeping the litter dry and preventing odors. However, superphosphate is the only material which prevents loss of nitrogen from the litter. Use it at about 25 pounds for each 100 square feet of floor space or 100 birds. Make the first application a few days after the initial litter is put into the house and apply again every few inches of litter build-up.

Permitting manure to accumulate in pen-type barns or in covered lots is an efficient and practical means of handling it if the right amount of bedding is used (9 pounds of straw per cow per day). The liquid will be absorbed, and tramping by the animals will keep the manure compact, which retards fermentation losses. Do not allow the accumulated manure to dry out after animals are removed or much ammonia will be lost. Likewise, either plow under or disk the manure into the soil as soon as it is applied, or large amounts of nitrogen will be released into the air.

In Storage—

It is often impractical or impossible to apply manure directly from the barn to the field. Some storage is usually necessary. Here are four ways to keep down losses of plant nutrients from stored manure:

1. **Compact it well to keep out air.**
2. **Keep it moist.**
3. **Keep it under a shelter to prevent leaching.**
4. **Do not fork over or disturb it.**

Storing manure under a roof in a closed shed is perhaps the best way to prevent leaching losses. Such a shed should have an watertight floor, four continuous walls, and a roof.

If you must store manure outside, place it in compact piles with straight sides and a flat top. Be sure to keep the manure moist and compact.

In the Field—

Except where pen-type barns or covered feedlots are used, haul manure directly to the field and spread it. This reduces losses, keeps the barn clean, and uses labor to a good advantage. The soluble fertilizer parts of manure are quickly fixed when they come into contact with moist soil. However, if fermented manure dries out before being rained on or worked into the soil, much of the nitrogen is lost as ammonia. To prevent this, spread during rainy periods or immediately disk or plow down if spread during dry weather. When unfermented (fresh) manure is applied, there is little danger of loss in this way.

Except on steep slopes or where an ice sheet has formed on the land, spread manure on frozen ground or on the snow. This usually will conserve nutrients better than leaving it in piles in the barnlot or field. When snow at the surface of frozen soil melts, a thin layer of soil also thaws so that it traps the fertilizer elements in manure spread on snow. Spreading on fall-plowed land or on pastures and meadows also helps prevent runoff losses in the spring. In case of a quick thaw, particularly on sloping land, some nutrients will be lost.

On steep land where runoff is a problem, hold off application until frost is out of the first few inches of the soil. If you don't have a good storage shed, haul the manure to piles near the field to be manured. Piles should be narrow enough so they will freeze through and not ferment. Do not put the manure in a number of small piles through the field for spreading later in the spring. This takes more labor and wastes nutrients.

MANAGEMENT OF MANURE

Preventing nutrient losses is not the only feature of good manure management. How you use manure in the field, with reference to crops, kind of soil, supplemental commercial fertilizers, and time and rate of application has much to do with getting the greatest net returns from each ton.

What crops are helped most? All crops gain from manure but truck and garden crops, grass crops,

and intertilled crops generally show the greatest stimulation. Corn, potatoes, and sugar beets use potash and nitrogen heavily and should probably receive a large part of the manure produced on the farm.

A light topdressing gives excellent results on legume meadows and pastures. Since livestock may hesitate to graze pastures for a short period after fresh manure is spread, cover only a portion of the pasture at one time.

There are some objections to applying manure on legumes, although it usually gives excellent results. If supplied with nitrogen from manure, legumes will not take much from the air and, thus, lose their soil-building value. Manure may introduce weed seeds into the hay field. Unless finely divided, the manure and particularly the bedding may interfere with the quality of the hay.

Small grains, particularly oats, tend to lodge when too much nitrogen is available. Best results will usually be obtained with small grains if the manure has been applied for a preceding cultivated crop.

What soil is helped most? Manure will produce the greatest benefits if applied to the lowest fertility soil on the farm. Areas where topsoil has been lost by erosion or where the soil is in poor tilth because of a lack of organic matter respond well.

Manuring is one of the best ways to improve high-lime or "alkali" spots.

Where soil is very sandy, manure will help while soluble fertilizer materials leach away easily.

What kind of applications should be made? Light, frequent applications of manure (4 to 8 tons per acre) bring better returns than heavy, infrequent treatments. Don't apply poultry manure at more than 3 tons per acre. Usually, where manure is applied in crop rotations, the crop just following the application responds more than subsequent crops.

Manure cannot be substituted for good cropping systems, good seed, proper drainage, or proper cultural practices. Unless the farm operator uses considerable feed not grown on his farm, the use of manure alone will not maintain soil fertility. Even if considerable feed is purchased for use on the farm, it is usually necessary to apply some phosphate to balance the manure. Likewise, manure is not a substitute for lime needs of acid soils.

Along with the difficulty of conserving all the nutrients, sale of many crops, livestock, or livestock products from the farm removes some fertility from the land.

Characteristics of Bedding Materials*

Material	Bedding required to absorb 100 pounds of liquid	Amount of ammonia absorbed by one ton of bedding	Plant food content per ton of air-dry material		
			Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)
			pounds		
Wheat straw	45	4.5	11	4	20
Chopped straw	20-30	4.5	11	4	20
Oat straw	35	7.1	12	4	26
Cornstalks (shredded)	25-30	5.3	15	8	18
Sawdust	25	0	4	2	4
Wood shavings	25-45	0	4	2	4
Peat	10-25	30-60	16-60	2	3

* Adapted from Salter, Robt. M., and Schollenberger, C. J. *Farm Manure.* Ohio Agr. Expt. Sta. Bul. 605. p. 11. September, 1939.

Production and Composition of Fresh Manure from Mature Farm Animals*

Animal	Daily production per animal		Amount of nutrients in one ton of solid and liquid			
	Solid	Liquid	Organic matter†	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
			pounds			
Cattle	52.0	20.0	388	9.0	6.0	8.4
Horses	35.5	8.0	482	11.0	5.5	13.2
Swine	6.0	3.5	376	13.0	12.7	9.6
Sheep	2.5	1.5	650	20.0	9.0	16.8
Poultry	0.1	.....	700	18.0	17.5	9.6

* Adapted from Salter, Robt. M., and Schollenberger, C. J. *Farm Manure.* Ohio Agr. Expt. Sta. Bul. 605, pp. 7, 18, and 38. September, 1939.

† Includes minimum amount of straw needed for absorption of liquid.

Increases in Yields of Crops Grown in Rotation after Application of Barnyard Manure

Location	Crop rotation	Years of data	Manure applied per rotation	Value of crop increase per ton manure*
			tons per acre	
Duluth	Oats, hay, hay, potatoes	30	10	$7.06
Duluth	Barley, hay, hay, potatoes	30	10	7.31
University Farm	Corn, oats, hay	30	6	4.31
Blue Earth	Corn, soybeans, oats, hay	4	8	2.58
Morris	Corn, wheat, oats, hay	10	8	3.01
Morris	Corn, wheat, barley, hay	8	8	2.03
St. Peter	Corn, corn, oats, hay	4	8	3.18
Average seven fields		.....	.....	$4.21

* Prices based on 10-year seasonal (12-month period following crop year) average prices 1941-50: hay $12.39 ton, oats $0.65, potatoes $1.16, barley $1.15, corn $1.18, soybeans $2.16, and wheat $1.71 bu. Price data from State-Federal Crop and Livestock Reporting Service. *Minnesota Agricultural Statistics.* 1949-50. p. 42. 1950.

To Get Full Value from Manure—

1. Conserve the liquid by using plenty of bedding and tight gutters and floors in the stable.

2. Prevent fermentation losses by either hauling immediately from the barn to the field or by using a preservative. Superphosphate is the best.

3. Provide good storage facilities if manure cannot be applied directly to the land.

4. If manure has fermented, apply it to the land during a rain or work it into the soil immediately after application.

5. Make manure a balanced fertilizer by supplementing its use with superphosphate.

6. Make frequent light applications of from 4 to 8 tons per acre rather than heavier, infrequent applications.

7. Use manure to improve soils low in organic matter, such as eroded slopes, sandy soils, or those in poor tilth.

8. Use good cropping systems, lime acid soils, and provide proper soil drainage and proper cultural practices along with the manure.

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